1

Language of Mathematics — A Corpus based Analysis of Textbooks

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Abstract

This paper tries to explore how Teaching Learning Materials (TLMs) for mathematics, particularly, textbooks developed by the National Council of Educational Research and Training (NCERT), recognise the importance of language in and for learning of mathematics. This has been done through an analysis of mathematics textbooks for Classes V, VI and VII. The paper tries to explore the role of language in teaching and learning of mathematics as realised in the textbooks. Besides, it tries to find out if mathematics textbook developers understand the role of language in explaining mathematical concepts.

LANGUAGE OF MATHEMATICS

There is a close relationship between mathematics and language. Eminent scholars across centuries, starting from Aristotle to Chomsky, have tried exploring this relationship.

Aristotle, a famous Greek philosopher and polymath, used mathematics to 'see' the invisible patterns of sounds recognised as music. He also used mathematics to describe the invisible structure of a dramatic performance. Noam Chomsky, a well-known American linguist, philosopher, cognitive scientist, historian, social critic and political activist, used mathematics to 'see' and describe the invisible, abstract patterns of words recognised as grammatical sentences. He, thereby, turned linguistics from a fairly obscure branch of anthropology to a thriving mathematical science. Mathematics is applied to look into the future, such as the following (Keith Devlin, 1998).

- The probability theory and mathematical statistics help predict the outcome of elections, often with remarkable accuracy.

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- Calculus is used for weather forecast.
- Market analysts use various mathematical theories for predicting the behaviour of the stock market.
- Insurance companies use statistics and probability theory to predict the likelihood of an accident, and fix the premium accordingly.

These points are comprehensible only when displayed graphically, i.e., explained in a natural human language. The language of mathematics or mathematics register[1] explains abstract ideas, making it distinct from other registers but comprehensible to all.

Importance of Words and Word Chunks in Learning

Encountering a word several times in a textbook reflects the high frequency of that word, which in turn, indicates its importance in teaching and learning. There is a theory on the vocabulary required to be learnt by students, for whom English is the second language (ESL), as opposed to those for whom it is the first language (EFL). For example, knowledge of the first 2,000 words of General Service List (GSL) (West, 1953) together with the Academic Word List (AWL) (Coxhead, 2000) would provide about 95 per cent of the vocabulary required for the reading of academic texts, essential for ESL and EFL students (Nation, 1990, 2001).

A corpus based content analysis of a textbook helps make decision as regards to the selection of text easier for teachers.

However, the basic criterion in teaching and learning of vocabulary is the underlying purpose, i.e., whether the aim is to learn the words for general use, academic use (English for academic purposes) or specialised use (English for specific purposes).

Frequency Count — Recurrent Words in Mathematics Textbooks

Corpus analysis[2] has gained importance in understanding language use in social and academic contexts. It reveals the stand the writer or narrator of text(s) takes and also the nature or characteristic of the subject. For instance, many corpus based studies on interactions between doctors and patients reveal how their ailments were described, diagnosed, treated and cured over a period of time.

A corpus analysis of mathematics textbooks of Classes V, VI and VII was conducted in order to list out the most frequently used words. The top 25 such words could be listed in each book. Besides, the most frequently used words in the first unit of each of these books were also analysed.

[1]In language studies, the term 'register' is defined as the way a speaker uses language differently in different situations. Registers are used in all forms of communication, including written and spoken, and formal and informal. A mathematics register is made up of specific uses of language for mathematical purposes.

[2]Corpus analysis is a type of text analysis that allows one to draw comparisons between textual objects on a large scale.

Word	Freq.	%	Texts	%	Lemmas
#	1,882	9.76	15	100.00	
THE	913	4.73	15	100.00	
A	547	2.84	15	100.00	
OF	450	2.33	14	93.33	
TO	358	1.86	15	100.00	
AND	311	1.61	15	100.00	
IS	297	1.54	15	100.00	
IN	280	1.45	14	93.33	
HOW	261	1.35	15	100.00	
YOU	244	1.27	14	93.33	
IT	176	0.91	14	93.33	
THIS	164	0.85	15	100.00	
I	160	0.83	14	93.33	
FOR	155	0.80	14	93.33	
ARE	150	0.78	13	86.67	
CAN	145	0.75	14	93.33	
WILL	133	0.69	13	86.67	
FROM	119	0.62	14	93.33	
HE	116	0.60	13	86.67	
MANY	114	0.59	11	73.33	
YOUR	107	0.55	13	86.67	
CHILDREN	106	0.55	12	80.00	
ON	103	0.53	14	93.33	
WHICH	96	0.50	13	86.67	
ONE	93	0.48	13	86.67	

Figure 1: Frequency count of the top 25 frequently appearing words in Math-Magic, mathematics textbook for Class V

N	Word	Freq.	%	Texts	%	Lemmas	Set
1	THE	47	4.74	1	100.00		
2	A	38	3.83	1	100.00		
3	BRICKS	35	3.53	1	100.00		
4	OF	34	3.43	1	100.00		
5	#	26	2.62	1	100.00		
6	BRICK	24	2.42	1	100.00		
7	IN	22	2.22	1	100.00		
8	YOU	22	2.22	1	100.00		
9	IS	19	1.92	1	100.00		
10	HOW	17	1.71	1	100.00		
11	AND	15	1.51	1	100.00		
12	TO	15	1.51	1	100.00		
13	THIS	14	1.41	1	100.00		
14	ARE	13	1.31	1	100.00		
15	ONE	12	1.21	1	100.00		
16	HAVE	11	1.11	1	100.00		
17	CAN	10	1.01	1	100.00		
18	FOR	10	1.01	1	100.00		
19	LOOK	10	1.01	1	100.00		
20	MADE	10	1.01	1	100.00		
21	PATTERNS	10	1.01	1	100.00		
22	SEE	10	1.01	1	100.00		
23	THESE	10	1.01	1	100.00		
24	FROM	9	0.91	1	100.00		
25	IT	9	0.91	1	100.00		

Figure 2: Frequency count of the top 25 frequently appearing words in the first unit of Math-Magic, mathematics textbook for Class V

N	Word	Freq	%	Texts	%
1	#	12,887	17.28	14	100.00
2	THE	4,170	5.59	14	100.00
3	OF	2,783	3.73	14	100.00
4	A	2,117	2.84	14	100.00
5	AND	1,582	2.12	14	100.00
6	IS	1,574	2.11	14	100.00
7	TO	1,141	1.53	14	100.00
8	IN	1,040	1.39	14	100.00
9	NUMBER	879	1.18	14	100.00
10	WE	766	1.03	14	100.00
11	ARE	706	0.95	14	100.00
12	BY	545	0.73	14	100.00
13	NUMBERS	544	0.73	9	64.29
14	YOU	476	0.64	14	100.00
15	B	466	0.62	14	100.00
16	THAT	456	0.61	14	100.00
17	AS	436	0.58	14	100.00
18	CAN	414	0.56	14	100.00
19	IT	411	0.55	14	100.00
20	FOR	374	0.50	13	92.86
21	THIS	360	0.48	14	100.00
22	ON	350	0.47	13	92.86
23	TWO	347	0.47	14	100.00
24	BE	341	0.46	14	100.00
25	FIND	336	0.45	14	100.00

Figure 3: Frequency count of the top 25 frequently appearing words in NCERT's Class VI Mathematics textbook

N	Word	Freq.	%	Texts	%	mmas	et
2	THE	410	5.19	1	100.00		
3	TO	179	2.26	1	100.00		
4	IS	165	2.09	1	100.00		
5	AND	164	2.07	1	100.00		
6	IN	153	1.93	1	100.00		
7	OF	143	1.81	1	100.00		
8	A	133	1.68	1	100.00		
9	NUMBER	122	1.54	1	100.00		
10	NUMBERS	113	1.43	1	100.00		
11	WE	103	1.30	1	100.00		
12	DIGIT	72	0.91	1	100.00		
13	YOU	63	0.80	1	100.00		
14	ARE	50	0.63	1	100.00		
15	AS	50	0.63	1	100.00		
16	FOR	47	0.59	1	100.00		
17	OFF	46	0.58	1	100.00		
18	IT	45	0.57	1	100.00		
19	PLACE	44	0.56	1	100.00		
20	CAN	43	0.54	1	100.00		
21	THIS	41	0.52	1	100.00		
22	DIGITS	39	0.49	1	100.00		
23	AT	38	0.48	1	100.00		
24	GREATEST	38	0.48	1	100.00		
25	HOW	38	0.48	1	100.00		

Figure 4: Frequency count of the top 25 frequently appearing words in the first unit of NCERT's Class VI Mathematics textbook

N	Word	Freq.	%	Texts	%	Lem
1	#	20,004	23.23	17	100.00	
2	THE	4,374	5.08	17	100.00	
3	OF	2,991	3.47	17	100.00	
4	A	2,415	2.80	16	94.12	
5	AND	1,671	1.94	17	100.00	
6	IS	1,545	1.79	16	94.12	
7	IN	1,098	1.27	16	94.12	
8	TO	991	1.15	16	94.12	
9	WE	845	0.98	16	94.12	
10	ARE	725	0.84	16	94.12	
11	I	708	0.82	16	94.12	
12	B	699	0.81	16	94.12	
13	THAT	589	0.68	15	88.24	
14	FOR	574	0.67	16	94.12	
15	II	566	0.66	16	94.12	
16	YOU	566	0.66	16	94.12	
17	CM	515	0.60	10	58.82	
18	FIND	494	0.57	16	94.12	
19	TWO	458	0.53	16	94.12	
20	FIG	451	0.52	10	58.82	
21	BY	437	0.51	16	94.12	
22	CAN	435	0.51	16	94.12	
23	NUMBER	427	0.50	15	88.24	
24	THIS	401	0.47	16	94.12	
25	BE	396	0.46	16	94.12	

Figure 5: Frequency count of the top 25 frequently appearing words in NCERT's Class VII Mathematics textbook

N	Word	Freq.	%	Texts	%	mmas	et
1	#	2,086	27.71	1	100.00		
2	A	293	3.89	1	100.00		
3	THE	261	3.47	1	100.00		
4	AND	175	2.32	1	100.00		
5	IS	163	2.16	1	100.00		
6	INTEGERS	158	2.10	1	100.00		
7	OF	154	2.05	1	100.00		
8	B	127	1.69	1	100.00		
9	WE	127	1.69	1	100.00		
10	INTEGER	123	1.63	1	100.00		
11	FOR	113	1.50	1	100.00		
12	IN	85	1.13	1	100.00		
13	NEGATIVE	71	0.94	1	100.00		
14	THAT	71	0.94	1	100.00		
15	C	68	0.90	1	100.00		
16	ARE	52	0.69	1	100.00		
17	I	49	0.65	1	100.00		
18	BY	48	0.64	1	100.00		
19	POSITIVE	44	0.58	1	100.00		
20	ANY	43	0.57	1	100.00		
21	CAN	43	0.57	1	100.00		
22	FOLLOWING	40	0.53	1	100.00		
23	NUMBER	40	0.53	1	100.00		
24	PRODUCT	40	0.53	1	100.00		
25	FIND	37	0.49	1	100.00		

Figure 6: Frequency count of the top 25 frequently appearing words in the first unit of NCERT's Class VII mathematics textbook

Some of the most frequently used words in the mathematics textbooks for Classes V, VI and VII are depicted in Figures 1–6.

Hence, it may be inferred that the most frequently used words are 'function' words and not 'content' words. Function words like 'the', 'a', 'and', 'to', 'for', 'this', 'that', etc., appear more than content words, for example, 'product', 'number', 'find', 'greatest', 'digits', etc. For instance, the word, 'number', appears only twice in the top 25 words in Class VI textbook. However, in the Class VII textbook, fundamental mathematical terms like 'integers', 'positive', 'negative', etc., appear. The function words as indicated in the figures are articles (a, the), prepositions (to, into, for), demonstratives (this, that) and conjunctions (and, but).

So, mathematics textbooks and mathematics teachers have as much responsibility as language teachers in teaching mathematical concepts. It is important for mathematics as a subject to realise the functions through a formulae or theorem. The function words (Figures 1, 2, 3, 4, 5 and 6) serve as placement words (prepositions) — words determining finiteness (determiners) or anonymity ('a' or 'the') and connectives (and, but, if). The most frequent use of the word, 'the', denotes how the subject of mathematics tries to drive home the point of definiteness, i.e., solution to a problem posed or arriving at a point of definite decision (solution) through problematisation.

Use of simple present tense and present time

The textbooks analysed mostly use present simple tense and present time. If a learner is working towards solving a multiplication problem, then one needs to keep oneself updated on how numbers get values as they are added. Another dimension is that it reveals the 'universal' element of mathematics, as in case of mathematical thinking and logical reasoning. This is because universal truths are reported in the present tense and time. There cannot be subjectivity in mathematics.

An example from *Mathematics* textbook for Class VI (NCERT, 2006c; Reprint, 2015) that uses simple present tense is as follows.

> What is the capacity of a bucket to hold water? It is, usually, 20 litres. Capacity is given in litres. But, sometimes, we need a smaller unit, it is millilitres...Note that in all these units, we have some common words like kilo, milli and centi. You should remember kilo is the largest and milli is the smallest (p. 16).

Use of 'can' (can you do mathematics?)

Mathematics is about solving mathematical problems. It involves active thinking and reasoning. There is no scope for 'passivity'. So, words like 'can' and 'find' are frequently used in the Class VI textbook to denote the aspect of 'capacity building' in the doer, in this case, learners. 'Can', as a verb, is found the maximum number of times in the textbook, along with imperative verbs like 'find', 'find out' and 'list'. Given are a few examples from the textbook.

- Can you find the difference in distance from C to D and D to E?
- Find out the time taken by the bus to reach (a) A to B (b) C to D (c) E to G (d) total journey (NCERT, 2006c; Reprint, 2015;p. 17).

Coherence markers[3]

Language is evolutionary in nature. The language used in mathematics textbooks needs to reflect on this aspect so as to enable the learners to understand and solve mathematical problems. The *Mathematics* textbook for Class VI addresses the learners directly, reducing the use of coherence markers. The content is presented in a way that no paragraph is longer than four sentences, except the introduction to each unit. Moreover, most of the sentences used are simple sentences.

Use of simple sentences and inference condition

A few compound and complex sentences have been used in NCERT's *Mathematics* textbook for Class VI. Coordinating conjunctions like 'and' and 'but' are also used to add an item or aspect. The following examples elucidate this point.

- The first, i.e., Fig. 4.11(i) is an open curve and the second, i.e., Fig. 4.11(ii) is a closed curve (p. 93–94).
- Draw five simple curves and five curves that are not simple (complex sentence) (p. 93).

[3]Coherence markers are words and phrases that denote a link between thoughts contained in a sentence(s) and a paragraph(s). These help a reader or listener to tie the sentences in the text together.

Another type of complex sentence frequently used in the textbook is the 'if' clause with 'then'. The following examples may be referred to.

- If each angle is less than 90°, then the triangle is called an acute angled triangle.
- If any one angle is a right angle, then the triangle is called a right angled triangle.
- If any one angle is greater than 90°, then the triangle is called an obtuse angled triangle (p. 130).

The use of 'if' clause enables one to understand the 'state of a condition', i.e., this is what exists or is possible. There are different types of conditional sentences and clauses in English language, viz., real and unreal, generic, habitual, inference, hypothetical and counterfactual conditional. All NCERT mathematics textbooks at the elementary stage use inference conditional clauses extensively. The Class VI *Mathematics* textbook is no exception.

Grammarian Cowan (2008:451) says: "In inference conditionals, the proposition in the result clause is inferred from the proposition in the 'if' clause. That is, inference conditionals say, 'If x, then y follows'. Of course, x may or may not be true, (i.e., as with other conditionals, it may or may not be fulfilled), but if x is true, the speaker says, then so is y, since it can be reasonably inferred from x."

This (the use of 'if' followed by 'then' in the same sentence) reveals the two essential characteristics of mathematics. Firstly, the aspect of problematisation or mathematisation, and secondly, the aspect of mathematicality. 'Mathematicality' refers to mathematical quality and formal accuracy to solve a problem. According to NCERT's *Position Paper on Teaching of Mathematics*, "What are the main goals of mathematics education in schools? Simply stated, there is one main goal — mathematisation of the child's thought processes. In the words of David Wheeler (1982), it is 'more useful to know how to mathematise than to know a lot of mathematics' (emphasis added)" (NCERT, 2006a:1).

Rubrics

The *Mathematics* textbook, like other textbooks, tries to interact with the learners through rubrics[4], which introduces a unit, provides additional information, and directs the information in exercises and student activities. Rubrics directly address the learners in the following ways.

- Can you recall a polygon with the least number of sides?
- Do you see that each one of them is greater than one–fourth of a revolution but less than half a revolution?
- What have we discussed?
- Think, discuss and write.

Imperatives

Instructive or imperative verbs like 'find', 'list', 'look', 'draw', 'choose' and 'identify' are found in all units and

[4]Rubric is a scoring tool that explicitly describes the instructor's performance expectations for an assignment or a piece of work.

all pages of the textbook for Class VI. This shows how mathematics actually helps the learners reach a solution or solve a problem logically. Given below are a few examples.

- Find ten situations where the angles made are acute.
- List five other situations where reflect angles may be seen.
- Look around and identify edges meeting at corners to produce angles. List ten such situations.
- Draw two perpendicular lines, one vertical and one horizontal.
- Choose a suitable scale along the vertical line.
- Find the LCM of the following numbers, in which one number is the factor of the other.
- Identify the measure of the fold which would be 90°+45° =135°

Personal pronouns

Pronouns like 'you' and 'we' are more frequently used than others. Some of the examples are as follows.

- Do you find a shortcut to multiply a number by number of the form 9,99,999...?
- Does this pattern help you add or subtract numbers of the form 9,99,999...?

As the book addresses the learners directly, it uses pronouns — 'you' and 'we'. Such language usage will enable the learners gain confidence.

Concord (collocations)

It refers to how a key word collocates, i.e., gets along with other words or phrases. Some of the examples are as follows.

- Articles — 'a' and 'the'
- Personal pronouns — 'you' and 'we'
- Present tense and time verb — 'be', 'is' and 'are'
- Content words — 'number' and 'numbers'

Collocation of 'a' and 'the'

Figures 7 and 8 present how the articles — 'a' and 'the' — collocate with other words. An analysis of the figures reveals that both 'a' and 'the' appear before content words. Supposition in the use of 'a' and definiteness in the use of 'the' is noticeable. This makes mathematicality, i.e., mathematical accuracy clearer to the learners.

Collocation of 'be', 'is' and 'are'

Usage of basic verb forms signifies the use of simple present tense and present time.

The language of mathematics is neutral, unambiguous and devoid of emotion. Also, there is no past and future in mathematics, only 'present'. To establish the 'is' of mathematics requires a lot of conditions (we can notice the use of 'if'...'then' in many definitions or formulae), which explain the reasons, effects and inferences. This becomes more difficult when abstract ideas are conveyed. Figures 9 and 10 show this phenomenon of 'neutral present'. The verb 'be' is used to state a fact of being, a condition or an expectation of some happening (say, change in the angle, multiplication, etc.). Modals like 'can', 'would', 'should'

and 'could' also appear before 'be' to ascertain the outcome. 'Be' is used as the main verb to caution the learners. So, it says, 'be careful'. The verbs — 'is' and its plural form 'are' — go along with the word 'perpendicular'. 'Is' is followed by words like 'observed', 'graduated', 'equal', and so on, while 'are' is followed by the main verb in passive voice like 'are given'.

N	Concordance	et	ag	Word #	Sent. #	nt. Pos	. #	Pos.	. #
1	etryGeometry We see a number of shapes with which we are			13	0	62%	0	0%	
2	has 8 bananas. Sunita has to go for a picnic with her friends. She wants to			28	1	64%	0	1%	
3	wants to arrange them in rows in such a way that each row has the same			45	1	52%	0	1%	
4	In our daily life, many a times we compare two quantities of the			35	0	80%	0	1%	
5	which we are familiar. We also make a lot of pictures. These pictures include			25	1	63%	0	1%	
6	sIdeas Geometry has a long and rich history. The term			32	0	89%	0	1%	
7	y Symmetry is quite a common term used in day to day life.			21	0	72%	0	1%	
8	Similarly, you must have also seen a cricket score board. Two score boards			47	1	73%	0	1%	
9	and seen so many line segments.A triangle is made of three, a			82	6	8%	0	1%	
10	(Fig. 10.1). You can make them with a wire or a string. If you start from the			62	4	67%	0	1%	
11	segments.A triangle is made of three, a quadrilateral of four line segments. A			88	6	58%	0	1%	
12	You can make them with a wire or a string. If you start from the point S in			65	4	92%	0	2%	
13	for development of Mathematics and as a result Mathematics grew further and			122	7	73%	0	2%	
14	overs Runs given Wickets taken A 10 2 40 3 B 10 1 30 2 C 10 2 20 1 D			70	2	42%	0	2%	
15	a quadrilateral of four line segments. A line segment is a fixed portion of a			94	7	18%	0	2%	
16	We know that the dot represents a decimal point. In this chapter, we will			74	6	80%	0	2%	
17	allow us to write rules and formulas in a general way. By using letters, we can			131	9	88%	0	2%	
18	of four line segments. A line segment is a fixed portion of a line. This makes it			98	7	55%	0	2%	
19	A line segment is a fixed portion of a line. This makes it possible to measure			102	7	91%	0	2%	
20	can talk about any number and not just a particular number. Secondly, letters			146	10	88%	0	2%	
21	line. This makes it possible to measure a line segment. This measure of each			110	8	80%	0	2%	
22	left was with all the 6 marbles in a row. Number of rows = 1 Total number			164	3	94%	0	2%	
23	This measure of each line segment is a unique number called its "length". We			120	9	64%	0	2%	
24	reach the point S. You have made a complete round of the MATHEMATICS			93	6	26%	0	2%	
25	to compare the lengths of an ant and a grasshopper, taking the difference			136	6	59%	0	2%	

Figure 7: The article, 'a', in collocation with other words

N	Concordance	et	ag	ord #	Sent. #	t. Pos	ra. #	a. Pos	. #	s
1	corner coincides with P. Step 5 Hold the set-square firmly in this position.			1,517	115	50%	0	41%		
2	firmly in this position. Draw PQ along the edge of the set-square. PQ is			1,526	116	56%	0	41%		
3	Step 4 Slide the set-square along the edge of ruler until its right angled			1,502	114	45%	0	41%		
4	right angled corner is in contact with the ruler. NCERTnot Step 4 Slide the			1,493	113	97%	0	41%		
5	with the ruler. NCERTnot Step 4 Slide the set-square along the edge of ruler			1,499	114	30%	0	41%		
6	position. Draw PQ along the edge of the set-square. PQ is perpendicular to l.			1,529	116	89%	0	42%		
7	use another set-square in the place of the 'ruler'? Think about it. Method of			1,563	120	92%	0	42%		
8	Method of ruler and compasses As is the preferred practice in Geometry, the			1,575	122	24%	0	43%		
9	at P. Can we use another set-square in the place of the 'ruler'? Think about it.			1,560	120	67%	0	42%		
10	is perpendicular to l. (How do you use the . symbol to say this?). Verify this by			1,540	118	55%	0	42%		
11	to say this?). Verify this by measuring the angle at P. Can we use another			1,550	119	67%	0	42%		
12	aligned edge of the ruler such that the right angled corner is in contact with			1,485	113	73%	0	40%		
13	us mark a point P anywhere on l. Fold the sheet such that l is reflected on itself;			1,366	104	13%	0	37%		
14	such that l is reflected on itself; adjust the fold so that the crease passes			1,376	104	54%	0	37%		
15	such that the lines on both sides of the fold overlap each other. Tracing			1,326	100	80%	0	36%		
16	to l through P. We can simply fold the paper such that the lines on both			1,316	100	30%	0	36%		
17	We can simply fold the paper such that the lines on both sides of the fold overlap			1,320	100	50%	0	36%		
18	on itself; adjust the fold so that the crease passes through the marked			1,380	104	71%	0	38%		
19	set-square with one of its edges along the already aligned edge of the ruler			1,476	113	45%	0	40%		
20	along the already aligned edge of the ruler such that the right angled			1,481	113	61%	0	40%		
21	a point P are given. Note that P is on the line l. Step 2 Place a ruler with one			1,445	110	78%	0	39%		
22	fold so that the crease passes through the marked point P. Open out; the			1,384	104	88%	0	38%		
23	through the marked point P. Open out; the crease is perpendicular to l. Think,			1,390	105	44%	0	38%		
24	ruler fixed. Slide the set-square along the ruler till the point P touches the other			1,854	139	33%	0	50%		
25	Slide the set-square along the ruler till the point P touches the other arm of the			1,857	139	50%	0	50%		

Figure 8: The article, 'the', in collocation with other words

N	Concordance	ef	ag	Word #	Sent. #	ent. Pos	#	ara. Pos	#	s
1	7. Repeat Question 6, if AB happens to be a diameter. 8. Draw a circle of radius			2,573	209	83%	0	70%		
2	if we take the length of radius to be smaller than half the length of AB?			2,681	220	77%	0	73%		
3	circle. The radius of your circle should be more than half the length of AB . Step			2,308	183	53%	0	63%		
4	Step 1 Let l be the given line and P be a point outside l. Step 2 Place a			1,803	135	84%	0	49%		
5	Do This Fold a sheet of paper. Let AB be the fold. Place an ink-dot X, as			2,075	157	67%	0	56%		
6	a 15° angle? Therefore, it can be constructed as follows : Step 1 Draw			3,267	287	23%	0	89%		
7	the following constructions can be made: (i) A circle, when the length of			3,576	313	19%	0	97%		
8	as B and C. BC? half the length be smaller than take radius to happen if			3,032	266	17%	0	82%		
9	the rays OA and OB coincide. Let OC be the crease of paper which is			2,952	251	27%	0	80%		
10	and compasses Let an angle, say, .A be given. Step 1 WithA as centre and			2,999	261	67%	0	82%		
11	(An optional activity) Step 1 Let l be the given line and P be a point			1,797	135	60%	0	49%		
12	in the exterior of the circle. 5. Let A, B be the centres of two circles of equal			530	42	21%	0	14%		
13	and compasses A better method would be to use compasses to construct a line			702	54	48%	0	19%		
14	compasses slowly to draw the circle. Be careful to complete the movement			392	32	18%	0	11%		
15	and compasses, only to draw arcs. Be careful while doing these			208	18	29%	0	6%		
16	we want the centre of the circle to be. Name it as O. Step 3 Place the			367	28	100%	0	10%		
17	paper or any transparent paper could be better for this activity. Let us take			1,338	101	69%	0	36%		
18	the dropping of a perpendicular can be achieved through the			1,586	122	53%	0	43%		
19	lines (or rays or segments) are said to be perpendicular if they intersect such			1,177	89	53%	0	32%		
20	CD . A second approach would be to use a transparent sheet and trace			995	73	30%	0	27%		
21	results. A better approach would be to use ruler and compasses for			1,023	75	40%	0	28%		
22	If you move towards image appear to be? where does your front of a mirror, If			1,559	125	100%	0	67%		
23	of the complete figure that would be seen when the design is cut off. 13.5			1,488	121	68%	0	64%		
24	that his walking distance AP + BP will be least? You can use reflectional			1,969	153	94%	0	84%		
25	A figure hasline symmetry if a line can be drawn dividing the figure into two			2,216	177	58%	0	95%		

Figure 9: Collocation of the verb, 'be'

N	Concordance	ef	ag	Word #	ent. #	Pos	ra. #	Pos	#	s
1	on l. Fold the sheet such that l is reflected on itself, adjust the fold so			1,371	104	33%	0	37%		
2	marked point P. Open out, the crease is perpendicular to l. Think, discuss and			1,392	105	67%	0	38%		
3	and write How would you check if it is perpendicular? Note that it passes			1,406	106	92%	0	38%		
4	sheet and a point P lying on the line. It is easy to have a perpendicular to l			1,302	99	25%	0	35%		
5	of AB . Step 1 Given AB whose length is not known. A B 278 PRACTICAL			1,045	77	80%	0	28%		
6	that cuts l at a point, say, D. Now CD is a copy of AB . EXERCISE 14.3 1.			1,115	84	50%	0	30%		
7	PQ such that the length of PQ is twice that of AB . 14.4 Perpendiculars			1,158	88	85%	0	31%		
8	l and a point P are given. Note that P is on the line l. Step 2 Place a ruler with			1,443	110	56%	0	39%		
9	each other. Open out. The crease is perpendicular to l and passes through			1,776	134	36%	0	48%		
10	and accurate method, of course, is the ruler-compasses method. Step 1			1,899	141	83%	0	52%		
11	suur Step 4 Join PQ. Thus, PQ is perpendicular to l. EXERCISE 14.4 1.			1,972	146	57%	0	54%		
12	suur Step 4 Join PQ. Then PQ is perpendicular to l. suur We write PQ .			1,662	126	31%	0	45%		
13	ruler such that the right angled corner is in contact with the ruler. NCERTnot			1,489	113	85%	0	40%		
14	along the edge of the set-square. PQ is perpendicular to l. (How do you use			1,532	117	50%	0	42%		
15	it. Method of ruler and compasses As is the preferred practice in Geometry,			1,574	122	21%	0	43%		
16	is the figure obtained? What figure is obtained if the diameters are			473	39	31%	0	13%		
17	mark points A, B and C such that (a) A is on the circle. (b) B is in the interior of			504	41	45%	0	14%		
18	C such that (a) A is on the circle. (b) B is in the interior of the circle. (c) C is in			510	41	61%	0	14%		
19	join the ends of these diameters, what is the figure obtained? What figure is			467	38	79%	0	13%		
20	the ruler in your instruments box is graduated into centimetres along one			130	12	39%	0	4%		
21	here. Every point on its boundary is at an equal distance from its centre.			278	21	50%	0	8%		
22	Construction of a circle when its radius is known Suppose we want to draw a			313	24	45%	0	9%		
23	B is in the interior of the circle. (c) C is in the exterior of the circle. 5. Let A, B			519	41	84%	0	14%		
24	to draw a line segment whose length is equal to that of a given line segment			946	71	70%	0	26%		
25	AB . A quick and natural approach is to use your ruler (which is marked			961	72	19%	0	26%		

Figure 10: Collocation of the verb ,'is'

Collocation of personal pronouns 'I' and 'we'

Personal pronouns like 'you' and 'we' have frequently been used in the Class VI *Mathematics* textbook. Figures 11 and 12 depict that 'you' is preceded by modal verbs, 'can' and 'will', and conditional 'if' to prompt or trigger thinking in the learners or to pose a condition for inferring a solution. The modals 'can' and 'will' are used to denote capability and prediction (the learners would do), respectively. 'You' is followed by action verbs like 'construct, 'list', 'find', 'do', 'join', 'check', and so on. This makes a learner connect with the problem. The use of the pronoun, 'we', makes the students feel that they have someone to depend on. This 'someone' may be the textbook, the teacher, the parent, or anyone working with the learners in solving the problem. The use of personal pronouns ensures the feeling of 'being with the learner', which is important for a teacher. The use of personal pronouns in the book, thus, makes it 'interactive' and 'participatory' in nature.

Conclusion

Recognising that all teachers are language teachers would, thus, enable material developers become language sensitive. Hence, the perspective of Language Across Curriculum (LAC) is evident. Teacher education courses, which address the issue of LAC

N	Concordance	eTag	Word #	ent. #	t. Pos	#	Pos	#	s.
1	l. Think, discuss and write How would you check if it is perpendicular? Note		1,402	106	62%	0	38%		
2	PQ is perpendicular to l. (How do you use the . symbol to say this?)		1,538	118	36%	0	42%		
3	Do This NCERTnot Where else do you see perpendicular lines around		1,226	92	62%	0	33%		
4	do you see perpendicular lines around you? Take a piece of paper. Fold it		1,231	92	100%	0	33%		
5	If M is the mid point of XY , what can you say about the lengths MX and XY?		2,496	201	73%	0	68%		
6	measure is 120°. NCERTnot How will you construct a 150° angle?		3,374	293	56%	0	92%		
7	This is the required 90° angle. How will you construct a 45° angle? EXERCISE		3,406	296	50%	0	93%		
8	initial point, draw two rays OA and OB . You got AOB . Fold the sheet through O		2,935	248	67%	0	80%		
9	but twice of an angle of 60°. How will you construct a 15° angle? Therefore, it		3,259	286	50%	0	89%		
10	twice that of AB . 14.4 Perpendiculars You know that two lines (or rays or		1,165	89	13%	0	32%		
11	Here are some tips to help you. (a) Draw thin lines and mark points		220	19	16%	0	6%		
12	an equal distance from its centre. Can you mention a few such objects and		287	22	27%	0	8%		
13	in earlier chapters as well. Why don't you list those shapes that you know		49	4	27%	0	1%		
14	Why don't you list those shapes that you know about alongwith how they		54	4	60%	0	1%		
15	and write How many circles can you draw with a given centre O and a		410	33	48%	0	11%		
16	copy of a given line segment Suppose you want to draw a line segment whose		937	71	40%	0	25%		
17	some line segment AB , whose length you do not know, construct PQ such that		1,146	88	41%	0	31%		
18	a circle and any two of its diameters. If you join the ends of these diameters,		459	38	21%	0	12%		
19	perpendicular to each other? How do you check your answer? 4. Draw any		485	40	57%	0	13%		
20	the reflection of the English letter M. You can imagine that the mirror is		1,525	124	8%	0	65%		
21	of symmetry. (Hint : It will be helpful if you first draw the lines of symmetry and		1,388	116	45%	0	59%		
22	where does your front of a mirror, If you are 100 cm in Do This NCERTnot		1,568	126	32%	0	67%		
23	image move? the mirror, how does If you move towards image appear to be?		1,553	125	54%	0	66%		
24	pattern known as Koch's Snowflake. (If you have access to a computer, browse		1,157	100	17%	0	49%		
25	everywhere! . Many road signs you see everyday have lines of		1,065	88	50%	0	45%		

Figure 11: Collocation of the personal pronoun, 'I'

N	Concordance	eTag	Word #	ent. #	Sent. Pos.	ra. #	. Pos. #
1	to measure its length with a ruler. If we know the length of a line segment, it		600	47	16%	0	16%
2	it by a diagram. Let us see how we do this. 14.3.1 Construction of a line		621	48	75%	0	17%
3	want to draw a circle of radius 3 cm. We need to use our compasses. Here		326	25	29%	0	9%
4	Mark a point with a sharp pencil where we want the centre of the circle to be.		359	28	60%	0	10%
5	line segment of a given length Suppose we want to draw a line segment of length		635	49	57%	0	17%
6	at the measuring device. Otherwise we will get an incorrect value. Use of		687	53	38%	0	19%
7	to have a perpendicular to l through P. We can simply fold the paper such that		1,312	100	10%	0	36%
8	draw a line segment of length 4.7 cm. We can use our ruler and mark two		646	50	11%	0	18%
9	AB . While marking the points A and B, we should look straight down at the		677	52	53%	0	18%
10	of shapes with which we are familiar. We also make a lot of pictures. These		22	1	25%	0	1%
11	pictures include different shapes. We have learnt about some of these		34	3	14%	0	1%
12	tryGeometryGeometry We see a number of shapes with which		11	0	52%	0	0%
13	see a number of shapes with which we are familiar. We also make a lot of		19	0	90%	0	1%
14	how they appear? In this chapter we shall learn to make these shapes. In		64	5	45%	0	2%
15	89101112139876543 21 We are going to consider "Ruler and		187	17	23%	0	5%
16	when its radius is known Suppose we want to draw a circle of radius 3 cm.		316	24	59%	0	9%
17	these shapes. In making these shapes we need to use some tools. We shall		75	6	55%	0	2%
18	shapes we need to use some tools. We shall begin with listing these tools,		81	7	12%	0	2%
19	this by measuring the angle at P. Can we use another set-square in the place		1,555	120	25%	0	42%
20	measure we do not know) is given and we want to make a copy of this angle.		2,765	227	75%	0	75%
21	to make a copy of this angle. As usual, we will have to use only a straight edge		2,776	228	27%	0	75%
22	and compasses, what would happen if we take the length of radius to be smaller		2,674	220	55%	0	73%
23	Suppose an angle (whose measure we do not know) is given and we want to		2,758	227	53%	0	75%
24	be smaller than take radius to happen if we wouldwhat In Step 2 above,		3,040	266	43%	0	83%
25	its supplementary angle. What have we discussed ? This chapter deals with		3,530	310	80%	0	96%

Figure 12: Collocation of the personal pronoun, 'we'

through concepts, need to intertwine language and mathematics.

The corpus based analysis of the language of mathematics textbooks reveals the importance of the use of functional aspect of language in mathematics. In the textbooks analysed, the most frequently used words are not content words but function words. According to Jamison (2000), "Once students understand HOW things are said, they can better understand WHAT is being said, and only then do they have a chance to know WHY it is said." Jamison is talking about how, what and why because these are not only related to the concepts of mathematics but language as well.

It is found that the textbooks mostly use simple sentences with only one verb. Further, some sentences using the construction—'if' and 'then'—are also found in mathematical problems. Moreover, the usage of present indefinite or present time in the textbooks indicates that mathematics is 'universal', i.e., neutral present, in nature.

The textbooks are interactive and address the learners directly, which is evident from the usage of personal pronouns 'you' and 'we'.

Therefore, it may be concluded that NCERT mathematics textbooks for Classes V, VI and VII are presented in a language appropriate to the age groups of the learners.

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